Kleinfelder

Memo

To: Bradley Waldrop, Steve Hiatt, Nolte

From: Christine Welch, Brett Whitford, Kleinfelder, Inc.

Project: 30-1307-10.001

Date: January 19, 2001

Re: Post Construction Seepage Assessment: Alternative #5, Reno Rail Corridor

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This memo presents the results of analyses Kleinfelder performed for the Alternative No. 5 trench profile. Our analyses included calculations of anticipated seepage along with anticipated evaporation on a monthly basis, for the long term, post-construction condition. An active maintenance program will be established to seal areas with incoming moisture. One source of seepage is condensation of water vapor which will pass through the walls and invert. The volume of seepage is dependant on the permeability of the concrete and the rate of evaporation. Permeability of concrete is a function of its quality and the quality of construction.

The present preferred option is to dispose of water in the trench is via the sanitary sewer. We have been asked by the team to further assess the potential for active seepage, requiring management, through the concrete walls and floor of the invert for the rail corridor. Therefore, the purpose of this further evaluation is to define the spectrum of possible flows based on the quality of concrete placed. As this analysis was being performed, the wall and invert design were still being finalized. We chose a conservative dimension for the reinforced concrete invert slab of 5.5 feet, and assumed 3 foot thick concrete walls.

Kleinfelder has taken a closer look at the seepage issue by trying to identify evaporation data by season and month. We previously presented information based on annual evaporation from ponds and lakes with an evaporation rate increase of 35% (a typical value used by soil and other scientists) for evaporation from the ground. Pond and lake data were used since these data are readily available in publications. Our “first cut” analysis indicated that the annual evaporation potential from the trench exceeded the seepage inflow by a factor of at least 3. To further this assessment, we researched numerous references and source locations to identify evaporation data for the Reno area. Source locations included: USGS, State Engineers Office, Nevada Department of Natural Resources, USDA Soil Conservation Service, Desert Research Institute, and the University of Nevada at Reno, MacKay School of Mines. We found evaporation data from three sources. The University of Nevada Reno installed a station at the campus to assess evaporation in October of 1999. The second set of data was obtained from a publication prepared by the Nevada Bureau of Mines and Geology, Report #48, "Statewide Potential Evapotranspiration Maps for Nevada", 1996 by Lisa Shevenall. This report contains pan evaporation for a station in Fallon (the closest to the study area) as well as equations for assessing corrections to the data given physical factors such as elevation. Kleinfelder used these data and equations to develop a second curve for annual evaporation, which is also presented on the attached graph. Lastly, we computed evaporation using the HELP model developed by the U.S. EPA. Source data for this model was obtained from the National Weather Service. This model is widely used for the design of landfill caps and other low permeability structures. Potential evaporation data from these sources are presented on the attached graph.

To assess the potential for the accumulation of liquid seepage in the trench, we assessed the potential inflow along 500 foot segments of the train way. Nine seepage scenarios were assessed. These scenarios consisted of assessing seepage using three permeability rates vs. evaporation using data derived from Shevenall, 1996, the HELP model and the UNR ET site.. For each of the evaporation data sets we assessed seepage through a three foot thick wall and five foot thick invert structure. We assumed permeability values for the concrete of 10^{-6} cm/sec (poor material) 10^{-7} cm/sec (typical material) and 10^{-9} cm/sec (enhanced material). Based on publications by the Portland Cement Association, and confirmed by our own Peer Review group, permeability values of $1x10^{-7}$ to $1x10^{-9}$ cm/sec or slower are typical, and attainable if good quality (low water/cement ratio) concrete is specified.

Results of this assessment shows the maximum expected seepage (defined as flow rate minus evaporation rate) occurs in December, with marked decreases in evaporation between November and February. It also shows that the potential for excessive seepage is related to the quality of the concrete used. Our study also shows that concrete material must be specified to have a permeability of no faster than $1x10^{-7}$ cm/sec, in order that evaporation rates will exceed seepage rates for all months of the year. This assessment presumes that seepage through joints will be limited, and corrected by an ongoing maintenance program. This aspect of the facility is important since we understand that the current plan for storm water management includes the discharge of the first half inch of precipitation (per event) to the sanitary sewer and subsequent discharge to the storm drain system. Thus the wall and floor system must be "tight" enough to significantly minimize the potential for groundwater to mix with storm water.

To insure that the concrete to construct the wall and invert slab has the appropriate properties, contract specifications will need to include submittal of a mix design that meets the permeability standard. Testing standards for the mix could also be specified that included an assessment of permeability using ASHTO method T277 or other applicable standards.